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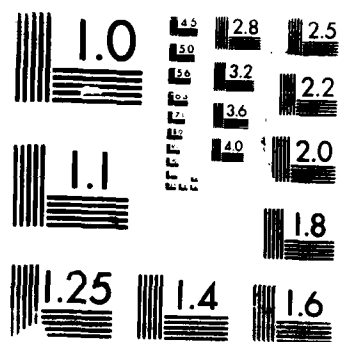
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# MILITARY MEDICINE

## ORIGINAL ARTICLES

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## Naval Support Activity Hospital, Danang, Combat Casualty Study

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The purpose of this paper is to describe a surgical data base that was constructed by the Naval Support Activity Hospital, Danang, which included all surgical admissions from January 1 to June 30, 1968. Variables included months of service in Vietnam, days on military operation, number of Purple Hearts, location at time of injury, wounding agent, casualty transit time, wound description, triage and operating room use, admission hematocrit, units of blood given, type of anesthesia administered, and disposition. This data base contains an extensive amount of clinical information and it describes a considerable part of the casualty experience.

### Introduction

Studies conducted during wartime of the combat casualty medical care system are done for a variety of reasons. They provide physicians, administrators, and other health care professionals with information about the system so that identified weaknesses can be corrected and well functioning aspects of the health care delivery system strengthened. Air evacuation, supply, administration, rehabilitation, and treatment techniques are examples of parts of the system that have benefited from such studies. Collections of these papers<sup>1-4</sup> are resources that can be used by medical planners and providers to make informed decisions during future conflicts and avoid repeating past mistakes. Such a casualty care study was undertaken during the Vietnam War by a group of Navy physicians and corpsmen. They examined the medical care given to surgical patients admitted to the Naval

Support Activity Hospital (NSAH), Danang, South Vietnam. The purpose of this paper is to present the results of a preliminary descriptive analysis of some aspects of the surgical data base (SDB) which they constructed.

### Background

In 1967 the Surgical Research Unit (SRU) embarked on a project to study combat casualty care at the NSAH. Their objectives were to collect and analyze pertinent medical data on each patient admitted to the surgical service from the time they arrived in the triage area to their discharge from the hospital or death. In 1967 the data collection methodology was determined and the study variables were selected. The data collection system was then tested and, where needed, appropriate modifications were made. The study covered the period from January 1 to June 30, 1968, and included a description of the patients' wounds, types of wounding agents, treatment, and disposition. The SRU staff included six hospital corpsmen who worked full-time on the study and were assigned no other duties, and two surgeons who worked on the study and treated patients at the same time. The surgeons had 18 months of combined experience in treating Vietnam combat casualties. The corpsmen were given extensive training on the standardized methods of recording pertinent medical information on the preprinted data collection sheets used in the study. These sheets were reviewed for completeness and accuracy by the SRU surgeons and then forwarded to the Naval Medical Research Institute (NMRI), Washington, D.C., for transfer to IBM punch cards and then to magnetic tape. The data were analyzed initially by Dr. James Garrick at NMRI in 1968, and a lecture describing the results of this study was presented in 1969.<sup>5</sup>

### Naval Health Research Center Analysis

No further analysis of the SDB occurred until 1984, at which time there was a renewed interest in Vietnam War casualties because such information was viewed as a resource for current contingency planning, and the Naval Health Research Center (NHRC) initiated a project to design a computerized combat casualty medical information system for

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the Fleet Marine Force.<sup>6</sup> After receiving a copy of the SDB, Center staff examined the accompanying documentation, identified missing data, and, where indicated in this technical report, recoded existing variables or generated new ones.

### Surgical Data Base

The original data base included all surgical casualties admitted to the NSAH between January and June 1968. However, it was decided by the SRU staff in 1968 that the SDB would contain only Allied casualties (J. Garrick, personal communication). The non-Allied casualties ( $n = 402$ ) were excluded from the SDB because their medical outcome would be difficult to determine.<sup>5</sup> Although there was no documentation on these casualties, this group probably included South Vietnamese, Koreans, prisoners of war, and others. Thus, the final number of admissions in the SDB was 2021, but there were only 2008 patients, because 13 patients were admitted twice during this six-month period. All admissions were due to injuries from weapons in combat, and all subjects in the study were males. Most of the patients in the SDB were Marine Corps enlisted personnel ( $N = 1182$ ); the remainder were Army enlisted personnel except for a small number of officers, other service personnel (Navy, Air Force, Coast Guard), and civilians.<sup>7</sup> Throughout this paper the use of the term "missing data" refers to data not recorded for a given variable; 9, 0, or 99, was used where applicable.

## Results

### Months of Service in Vietnam and Days on Operation

More than 50% of the admissions occurred when the patient had been in Vietnam 4 months or less, and 95.5% of the admissions occurred within 12 months ( $N = 1878$ , mean = 5.32 months; SD = 4.13; missing data = 143) (see Fig. 1). In the SDB, 55.9% of the admissions occurred on the first operational day, and 75.9% were within the first four operational days ( $N = 1479$ , missing data = 542) (see Fig. 2).

### Purple Hearts

The SRU staff attempted to determine how many times the patients were wounded prior to their admission in order

### Number of Days on Operation

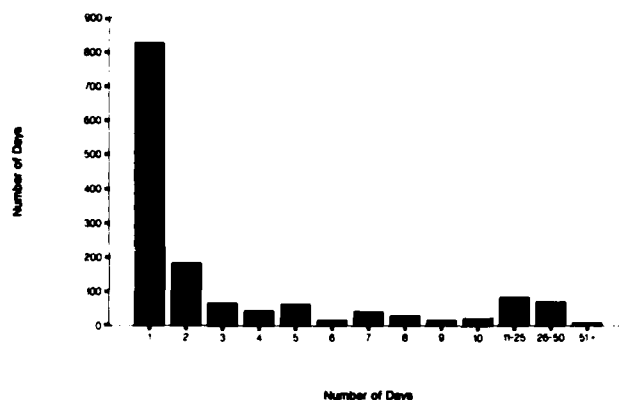


Fig. 2. Number of days on operation at time of admission.

to gain some measure of their combat experience. This was done by recording the number of Purple Hearts awarded to the patients while serving in Vietnam, as shown in Table 1. Most personnel (79.6%) were not previously wounded.

### Terrain of the Injury

The geographic location or terrain in which the patient's injury took place was coded in one or more of six variables (Table 2). Most of the sites were "afoot" (83.0%), with "afoot-dry" accounting for the largest single category (69.2%).

TABLE 1

#### DISTRIBUTION OF PURPLE HEARTS AWARDED PRIOR TO ADMISSION

No. of Purple Heart Awards	No. of Patients Receiving Award	%
0	1,609	79.6
1	191	9.5
2	38	1.9
3	3	0.1
Missing data	180	8.9
Total	2021	100.0

TABLE 2

#### DISTRIBUTION OF NUMBER OF CASUALTIES BY LOCATION OF INJURY

Location of Injury	Number of Casualties	%
Afoot-dry	1398	69.17
Afoot-wet	278	13.76
Other terrain	115	5.69
Ground vehicle	114	5.64
Building	62	3.07
Aircraft	52	2.57
Multiple cases	1	0.05
Missing data	1	0.05
Total	2021	100.00

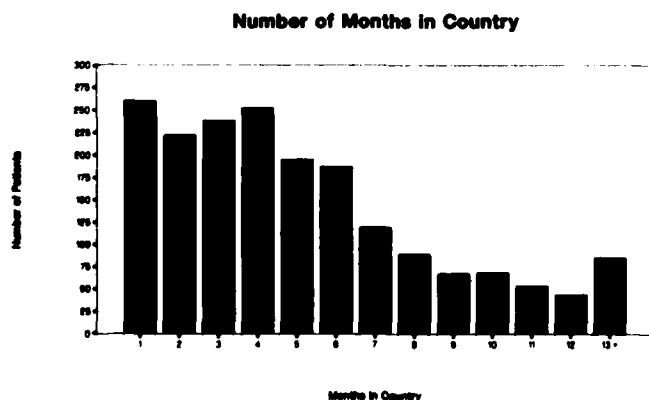


Fig. 1. Number of months of service in Vietnam at time of admission.

### Wounding Agents

Wounding agents were divided into two major categories: primary and secondary (Table 3). Primary wounding agents were those that could be coded independently of each other. The secondary agents, M-26 grenade and M-79 (grenade launching system), when known, documented the specific identity of one of the following primary agents: thrown grenade, mine, or booby-trap grenades. It was determined that some of the SDB records had the following characteristics: no primary or secondary agent listed; a secondary agent listed but not a primary one; or multiple primary causes but not coded in "multiple agents." To deal with these situations, the original wounding agents were recoded and a new category, "Grenade-Mine-Booby-trap-Other," was generated. Cases with multiple causes were recoded as "Multiple." The Recoded Wounding Agents (RWA) variable was constructed after taking the factors noted above into account. Artillery, mortars, and rockets were the largest single category of RWA, accounting for 38.9% of the total. The second largest category was rifles and pistols (23.8%), and, when combined, the categories of booby-traps, mines, and grenades accounted for 27.7% of the total. Burning agents included burning vehicles and buildings and white phosphorus.

### Casualty Transit Time

The casualty transit time (time to transport a casualty from the location of injury to the NSAH surgical triage area, including transfers from other treatment facilities) was always of concern to physicians, and attempts were made to reduce it as much as possible. The SDB indicated that the transit time for 48.4% of the admissions to NSAH was within two hours of injury, and the mean transit time for all admissions was 4.9 hours (range 0.05–98;  $N = 1926$ ; missing data = 95) (Fig. 3).

**TABLE 3**  
TYPE OF WOUNDING AGENT AS ORIGINALLY CODED AND RECODED

Type of Wounding Agent	Original Data Base	Recoded Wounding Agents	% RWA
<b>Primary</b>			
Artillery, mortars, and rockets	825	787	38.9
Rifles, pistols	526	481	23.8
Booby-trap grenade (small fragment)	189	187	9.3
Thrown grenade	171	147	7.3
Mine	163	146	7.2
Agent not known	87	86	4.3
Multiple agents	62	81	4.0
Booby-trap grenade (large fragment)	47	47	2.3
Grenade-Mine-Booby-trap-Other	0	32	1.6
Other weapon	24	21	1.0
Burning agents	34	6	0.3
<b>Secondary</b>			
M-26 grenade	58	0	
M-79 grenade	23	0	
<b>Total</b>	<b>2209</b>	<b>2021</b>	<b>100.0</b>

**Casualty Transit Time**  
Hours From Injury to Admission to NSAH

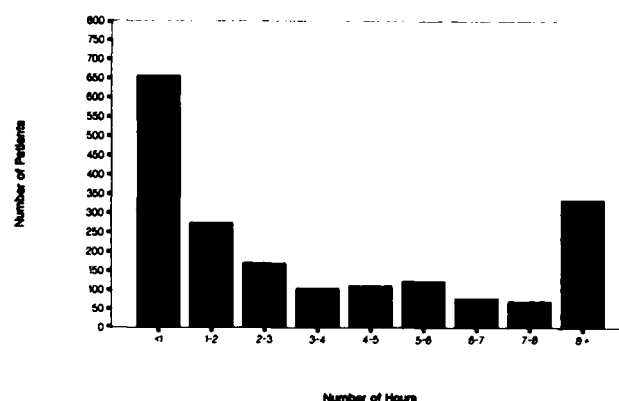


Fig. 3. Casualty transit time from injury to NSAH.

### Wound Descriptions

The SDB contained considerable information describing the patients' wounds. Table 4 lists a selection of specific organs or sites and their corresponding frequency of injury.

**TABLE 4**  
DISTRIBUTION OF INJURIES BY ANATOMICAL PART

Anatomical Part	Frequency of Occurrence of Injury	%
Head (penetrating)	199	7.6
Head (non-penetrating)	185	7.1
Eye	157	6.0
Oral	60	2.3
Facial (ENT*)	193	7.4
Facial (non-ENT)	315	12.0
Neck	217	8.3
Carotid artery	13	0.5
Jugular vein	9	0.3
Trachea	16	0.6
Esophagus	4	0.2
Thorax (penetrating)	117	4.5
Thorax (non-penetrating)	228	8.7
Diaphragm	10	0.4
Back (spine)	46	1.8
Back (non-spine)	196	7.5
Abdomen (penetrating)	199	7.6
Abdomen (non-penetrating)	109	4.2
Liver	39	1.5
Spleen	18	0.7
Pancreas	3	0.1
Kidney	17	0.6
Stomach	18	0.7
Duodenum	5	0.2
Small intestine	67	2.6
Colon	57	2.2
Rectum	10	0.4
Bladder or urethra	13	0.5
Genitalia	102	3.9
Vena cava	2	0.1
<b>Total Injuries</b>	<b>2624</b>	<b>100.0</b>

\* ENT Ear, Nose, and Throat.

The wound descriptions presented in Table 4 were combined with other wound descriptions in the SDB and collapsed into six principal groups (Table 5). Wounds to extremities in this table accounted for 68.2% of all wounds.

### Triage and Operating Rooms

Two triage areas capable of handling a total of 28 patients and a resuscitation holding area for 10 patients were used for those patients requiring extensive preparation for surgery. The total number of patients in triage at the time of the index patient's admission varied from 0 to 65 ( $N = 2009$ , mean = 7.37, SD = 7.75, missing data = 12). The mean time in triage was 1.9 hours (SD = 1.9, range 0.8–48.5,  $N = 1954$ ). For this variable there was no information available for 67 admissions. There were two major (four-surgeon capacity) and three minor operating rooms (one- to two-surgeon capacity). The operating room was used for 1214 admissions and the orthopedic clinic for 755 admissions for the initial surgery. Table 6 lists the hospital surgical staff.

### Admission Hematocrit and Units of Blood Given at Initial Surgery

The mean admission hematocrit was 38.8 ( $N = 847$ , SD = 5.32, range 14–51, missing data = 1174). Blood was given during the initial surgery for 516 (25.5%) of the admissions, with a mean of 6.10 units of blood infused (SD = 7.21). Eighty-seven percent of the patients receiving blood were given 10 units or less (Table 7). A total of 3148 units of blood was given at initial surgery during the study period.

TABLE 5

#### DISTRIBUTION OF WOUNDS BY ANATOMICAL GROUP

Anatomical Group	Frequency of Wounds	%
Head	1109	13.2
Neck	282	3.3
Thorax	614	7.3
Abdomen	675	8.0
Upper extremity	2333	27.7
Lower extremity*	3417	40.5
Total Wounds	8430	100.0

\* Includes genitalia wounds.  $N = 102$

TABLE 6

#### DISTRIBUTION OF HOSPITAL SURGICAL STAFF

Speciality	Specialty Number
Anesthesiologist	3
Anesthetist (nurse)	2
General Surgeon	3
Orthopedic Surgeon	4
Neurosurgeon	2
Urologist	1
Ophthalmologist	1
Otorhinolaryngologist	1
Oral Surgeon	1
Surgical General Medical Officer	3

### Anesthesia

During the initial surgical procedure, four types of anesthesia were used. Eighty-three patients were not given anesthesia, and 1747 had one type, of which 709 were general, 196 were spinal, 95 were regional, and 747 were local. One hundred and eighty-four patients had two types, and seven were given three types of anesthesia.

### Disposition

The types of discharges from the surgical service fell into one of six categories. "To duty" meant that the patient had relatively minor wounds and was kept at the hospital until he could return to full duty at his unit. The category "in country" consisted of patients sent to other medical facilities in Vietnam for further care. "Hospital ship" referred to transfer to the USS Repose or USS Sanctuary, which were operating off the coast of Vietnam. "West-PAC" referred to United States military treatment facilities located in the Western Pacific, such as Japan, Guam, and the Philippine Islands. Most (61.7%) patients went to West-PAC (Table 8). The mean length of time from admission to release from the hospital or death was 4.34 days (admissions = 2008, SD = 4.85, range 1–52). Of the 2021 admissions, there were 59 (2.92%) deaths, and of this group 17 were declared non-salvageable at the time of their admission. Therefore, 42 died while receiving treatment at the hospital.

TABLE 7

#### DISTRIBUTION OF SURGICAL CASES BY UNITS OF BLOOD ADMINISTERED

Units of Blood	Number of Cases	%
1	80	15.5
2	118	22.9
3	52	10.1
4	63	12.2
5	25	4.8
6	30	5.8
7	15	2.9
8	32	6.2
9	17	3.3
10	18	3.5
11–51	66	12.8
Total Units of Blood	516	100.0

TABLE 8

#### DISTRIBUTION OF CASUALTIES BY TYPE OF DISPOSITION

Type of Disposition	Frequency	%
To duty	160	7.9
In-country	312	15.4
Hospital Ship	183	9.1
West-PAC	1246	61.7
CONUS*	49	2.4
Deaths	59	2.9
Missing data	12	0.6
Total admissions	2021	100.0

\* CONUS = continental United States.

### Marine Corps Sample

Marine Corps personnel were identified by matching service numbers of casualties in the SDB file against the data base for all Marines hospitalized with wounds in Vietnam which is maintained at the NHRC. The 1182 Marines so identified were studied separately to determine their demographic and service characteristics. The mean age was 20.7 years and the mean length of service was 1.9 years. Most were white (87.4%); 12.4% were black, and 0.2% were other. The distribution of pay grade was: E1 through E3, 71.2%; E4 through E6, 25.6%; E7 through Warrant Officer, 0.5%; Officers, 2.7%. Occupation specialties were: infantry 71.8%, operations 4.9%, construction 4.6%, artillery 2.2%, aviation support 1.4%, administration 0.9%, and intelligence 0.2%.

### Discussion

The results indicate that the majority of the casualties admitted to NSAH were representative of what is generally known about those who served in Vietnam; they were mostly young infantrymen, in the service less than two years, and white.<sup>7</sup> In addition to being young, the majority of casualties had served little time in Vietnam and had been on their operation only a few days when they were wounded. These findings reflected the policy which limited most tours in Vietnam to one year as well as the characteristically short and intense combat operations which took place. These factors, along with the lack of previous wounds (as indicated by the number of Purple Hearts), point to the lack of combat experience among the casualties.

The weapons causing the greatest percentage of casualties in the SDB were artillery, mortars, and rockets, followed by rifles and pistols. However, collectively, mines and booby traps accounted for 27.7% of the total injuries. The use of the M-26 grenade against American soldiers was noteworthy. It was an American-made weapon that was stolen by the Viet Cong and North Vietnamese and often used to make booby traps. The construction of the grenade (notched wire wrapped around an explosive core) caused many small puncture wounds.

Combat casualties were generally taken to NSAH via helicopter and without primary definitive care. It has been suggested<sup>8</sup> that the speed with which the injured were taken to a hospital was the most unique medical feature of the Vietnam War. The transit time during World War I was generally 12 to 18 hours, during World War II it was 6 to 12 hours, and during the Korean War it was 2 to 4 hours.<sup>9</sup> Studies of Vietnam casualties generally state that the transit time was less than two hours.<sup>9</sup> However, in this study of seriously wounded casualties transported to a surgical facility, the mean was nearly five hours. Some of these lengthy transit times may be accounted for by the fact that some admissions were transfers from other medical facilities. One of the present authors (J.G.) recalled that other variables influencing the transit time for helicopter evacuations were time of day (night flying was considerably more difficult and dangerous), location of the wounded, transit distance, the number of casualties needing evacuation, and weather conditions.

The distribution of the site of wounds in the SDB is similar to that seen in both World War II and Korea,<sup>9,10</sup> with the majority of wounds occurring in the lower and upper extremities, followed by head wounds. The use of body armor was not reported in the SDB; however, the pattern of wound site (fewer thorax and abdominal injuries) was consistent with the use of "flak vests" by Marines.<sup>8</sup> The types of casualties sent to NSAH were not representative of all those occurring in Vietnam because the NSAH was staffed by a larger variety of specialists and thus more capable of handling difficult medical problems.

After triage, patients admitted to the surgical service went to the operating room, orthopedic clinic, or directly to the ward. The results indicated that there were as many as 65 patients in triage at one time. The time in triage was influenced by several factors. This included the time needed to resuscitate patients, the availability of the operating rooms, and the number of available staff. Another factor was the length of time it took to produce X-ray films. In the beginning of the study there were two X-ray machines and one automatic film processor. This was supplemented with a second processor that was promptly destroyed by enemy action. Therefore, only one processor was available during the study, and because it could only keep up with one X-ray machine, only one X-ray machine was used.

Hematocrits were routinely drawn on all severely wounded casualties. The mean of 38.8 was within the normal range of 38 to 54; however, there were several cases that were below normal, reflected by the lowest value of 14. Decisions regarding blood replacement were more often based on the magnitude of obvious bleeding and vital signs. In many instances evacuation and initial treatment occurred too rapidly for hemodilution to occur, thus yielding hematocrit values that did not accurately reflect blood loss. The type of anesthesia given was partially influenced by the availability of the anesthesiologist. There were times, especially during the Tet Offensive, that anesthesiologists worked continuously for 48 hours or more. This resulted in their periodic non-availability and, thus, a greater use of local and regional anesthesia and less use of general and spinal anesthesia. The factors influencing the length of the hospitalization were medical and logistical in nature. Patient census, availability of medical evacuation aircraft, and weather were the most significant non-medical determinants.

### Summary

Two unique features of this data base are the extensive amount of clinical information that was collected and the attempt to describe the entire casualty experience. Prehospitalization information on such variables as wounding agents and location of injury were combined with wound descriptions, treatment, and disposition. This data base provides an opportunity to follow the treatment process for casualties in a combat zone in a comprehensive and detailed way. As such, it offers an opportunity for further analysis in several areas. Deaths, wounding patterns, and blood use are but a few examples of these areas. This data base could also be combined with data from the Veterans Administration

medical records to determine the long-term medical outcome. Finally, the Surgical Data Base could be used as a model for future combat casualty care data collection efforts and to assist in the design of planned automation capabilities.

### Acknowledgments

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The objective of this paper was to provide a description of the casualties admitted to NSAH, Danang, during the period 1 January to 30 June 1968. Data collected at NSAH during this six-month period was used to determine the number of months in service in Vietnam, days on operation, combat experience, location at time of injury, wounding agent, casualty transit time, wound description, triage and operating room use, admission hematocrit, units of blood given, type of anesthesia administered, and disposition. Demographic information was obtained by matching the service numbers to the record of the Naval Health Research		

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Center hospitalization and career data base. The results indicate that the majority of the casualties admitted to NSAH were Caucasian, infantrymen, less than 25 years old, and in the service less than two years. Artillery, mortars, and rockets accounted for the largest number of admissions. Most casualties were admitted to NSAH within five hours of injury. The majority of the injuries occurred in the lower and upper extremities. The demographic information indicated that the casualties were representative of what is generally known about those who served in Vietnam. The injury and wounding agents descriptions were reflective of the nature of combat occurring in the Vietnam War.

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